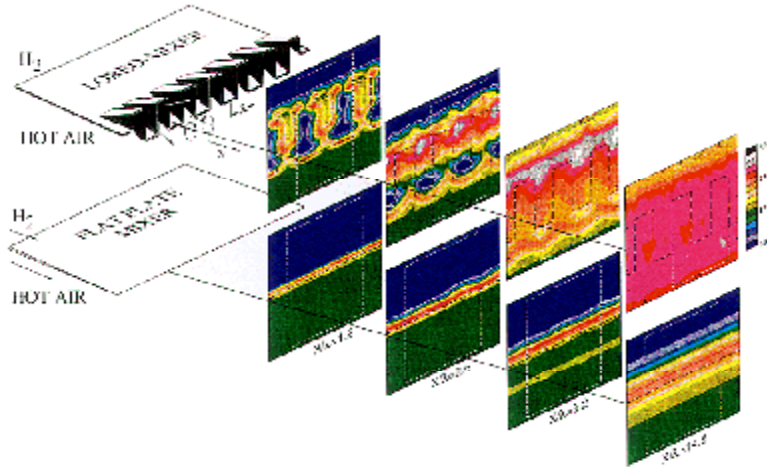


Stable Lobed Mixer With Combustion Demonstrated and Measured



Stable lobed mixer with combustion.

The NASA Lewis Research Center collaborated with the Massachusetts Institute of Technology (MIT) on an experiment to study the use of lobed mixers to improve the fuel-air mixing process and increase combustion intensity in combustors with minimal pressure loss. This experiment is the first known stable combustor flow studied for this device, and the data show a much faster and much more uniform combustion process than for flat-plate mixers. Several potential benefits may be realized from this study in future combustors, including a reduction in NO_x emissions because of the more uniform temperature distribution.

The experiment was done in Lewis' Planar Reacting Shear Layer facility, which was adapted to accept a lobed mixer in addition to the original planar tip. A graduate student at MIT provided the mixer design concept, and Lewis provided the engineering, operations, and research expertise.

The experiment used hydrogen-nitrogen mixtures to react with vitiated hot air at 920 K. A flow speed of about 120 m/sec and a speed ratio of 0.5 were used. Flow diagnostics consisted of traversing fine-wire thermocouples and pitot probes for flow mapping. Supplementary fluorescence images were taken with a charged coupled device (CCD) camera to show the location and temporal behavior of the reaction zone.

The data showed that the lobed mixer consumed the reactants between 3 to 10 times faster than a corresponding planar shear layer. The figure shows the dramatic difference in the measured temperature distribution with and without the lobed mixer. The increased mixing rate was due to a larger interfacial area as well as to the secondary flow from the streamwise vortices off the tips of the lobes. In addition, the fluorescence images showed that the lobes acted as flame stabilizers.

This Lewis-funded program (funded through a cooperative agreement), which resulted in a Masters' thesis, was conducted over 3 years and was finished at the end of June 1995. The series of experiments showed that the reacting shear layer is a potential combustion device for high-speed combustors where low pressure loss is required. It would be applicable to ramjets, afterburners, or combustors of complex cycles.

Bibliography

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